CLIMATE PRETABILITY FOR ADMINISTRATIVE REGIONS OF REPUBLIC OF MOLDOVA USING GEOGRAPHICAL INFORMATIONAL SISTEMS

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Резюме: Географические Информационные Системы (ГИС технологии) и балловый оценочный метод позволили решить одну из самых сложных задач прикладной агроклиматологии – оценку степени пригодности климата для возделывания сельскохозяйственных культур на уровне административных районов. Полученные результаты позволяют обеспечить потребителей (государственные органы или частные лица) актуализированной климатической информацией.

Key words: pretability, grading method, agroclimatic indexes, heat resources, humidity resources, GIS

Rezumat: Sistemele Informaţionale Geografice împreună cu metoda estimativă prin pontaje a permis rezolvarea uneia dintre cele mai dificile sarcini în agroclimatologia aplictivă şi anume evaluarea gradului de pretabilitate a climei pentru dezvoltarea anumitor grupuri de culturi agricole la nivel de raion administrativ. Rezultatele obţinute permit asigurarea consumatorului de informaţie climatică, în special organele de conducere şi persoanele private din agricultură, cu informaţie actualizată.

Cuvinte cheie: pretabilitate, metoda prin pontaje, indici agroclimatici, resurse de căldură, resurse de umiditate, SIG

Introduction

One of the most vulnerable fields of national economy to climate changes is agriculture. New sorts creation and application of agricultural plants' cultivation technologies does not mitigate its dependence on unfavorable climatic conditions. Complex evaluation of heat and humidity resources is one of the acutest issues in present, especially at local level, from which agricultural plants productivity mostly depends.

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This is not to mention that there only several attempts at integral evaluation of agroclimatic indexes. This is the reason why agroclimatic resources zonation is complicated or has subjective character. [1].

Continuous perfection of investigation methods, necessity of database actualization, regional climate's modification as a consequence of climate changes, agrarian orientation of national economy need climate pretability estimation for agricultural development in administrative regions. Obtained results can provide end-users with climatic information (especially authorities and private sector) actualized in this field.

Initial materials and investigation methods

As we mentioned before, one of the principal objectives of agroclimatic potential estimation at present is an open problem of identifying agroclimatic indexes as numbers and possibility of their spatial interpretation to certain taxonomical territorial units.

Possibilities offered by Geographical Informational Systems essentially widen the range of agroclimatic indexes, thus changing estimation criteria of agroclimatic potential according to: annual sum of atmospheric precipitations, mm; warm period sum of atmospheric precipitations, mm; cold period sum of atmospheric precipitations, mm; Seleaninov's hydrothermic coefficient; maximum heights of snow layer, cm; frost period duration, days; non-frost period duration, days; active temperatures sum (T>10C); number of days with T>5C; 10 % ensurance of absolute minimum of the year.

Thus, agroclimatic resources characterization and analysis on the administrative territorial level will be executed not by construction or identification of areas [2], but based on digital cartographic material that reflects pretability degree of agricultural development, estimated according to grading method. We should mention that by Geographical Informational Systems using for each cartographic model we can determine predominant maximum and minimum values rate automatically in territorial distribution.

Climate pretability evaluation criteria for pomiculture development on administrative regions' level were selected according to principles of evaluation criteria selection for climate pretability evaluation in Republic of Moldova in physical-geographical regions. We should mention that cultural

plants requirements for thermic and humidity regime in growth and development phases were the basis of these criteria selection.

Moreover, in proposed investigations we took into account critical thermic thresholds of the cultural plants for frost, using critical temperature data of fruit orchards frost damaging in cold season, number of hours with $T>5^{0C}$ in cold season, number of hours with $T<10^{0}C$ in cold season, fruit trees requirements for heat in active vegetation period, fruit trees requirements for humidity in active vegetation period.

Obtained results analysis

After producing complex analysis of agroclimatic indexes we have elaborated evaluation criteria of climatic pretability level for certain groups of fruit crops. For example, in tab. 1 are presented pretability level evaluation criteria for thermophile plants. Thus, the highest grading is due to the agroclimatic resources that are characterized with the most favorable wintering conditions, when average from absolute minimum does not exceed $-20^{0}C$, and snow layer may reach 19-23 cm, duration of days with diurnal temperatures more than $5^{0}C$ is the longest (240 days), active temperatures sum is more than $3200^{0}C$, frost period is the shortest (70 days) and with the most significant humidity resources, among which we should mention annual precipitations sum (650 mm) and Seleaninov's hydrothermic coefficient's values (1.4-1.7).

Thus, according to this system, the highest grade („4") is attributed to optimal climatic conditions. And vice versa, the most non-pretable agroclimatic resources for certain groups of agricultural plants have the lowest grade („1"). According to these qualificatives, all agroclimatic resources referenced to pomiculture development are grouped into:
optimal (3,5-4,0), favorable (2,9-3,4), pretable (2,3-2,8), less pretable (1,7-2,2), non- pretable (1-1,6)

Table 1. Evaluation criteria of climate pretability level for fruit crops with decreased requirements for water and increased ones for heat and frost resistance (peach, apricot, almond)

Grading	Absolute Minimum	Annual Precipitations	Sum summer period Precipitations (mm)	Winter period Precipitations (mm)	CHT	Frost period duration (days)	Non-Frost period duration (days))	Snow layer height	Sum of t>10^{0}C	Days Number with $_0$
1	<-23	450-500	149-180	<95	<0,9	>85	275-280	9-11	2800 - 2900	220-
2	-22	500-550	180-210	95-105	0,9-1,1	80-85	280-285	11-13	2900 - 3100	230-235
								13-15		
3	-21	550-650	210-240	105-115	1,1-1,4	70-80	285-295	15-17	3100 - 3200	235-240
								17-19		
4	>-20	>650	240-284	>115	1,4-1,7	<70	>295	19-21	>3200	>240
								21-23		

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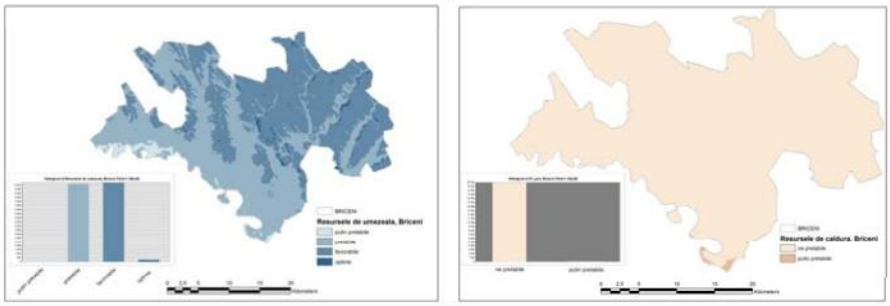
a b



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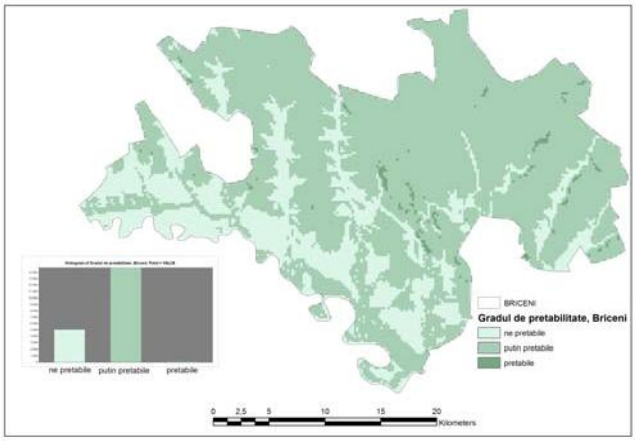


Fig.1. Heat and humidity resources pretability evaluation (a, b) and agroclimatic ones (c) with the reference of pomiculture development in republic's North (Briceni)

The most non-pretable agroclimatic resources graded to down till one unit are extreme wintering conditions with average values of absolute minimum lower than -23^0C, with most insignificant active temperature sums (2800-2900^{0}C), with the longest frost periods duration, and least number of days with diurnal temperature above 5^0C (220 days), etc.

We should also mention that for climate pretability evaluation for certain groups of agricultural plants we took into account their biological

particularities and needs for light, temperature, precipitations etc., which would be reflected in evaluation criteria for climate pretability of certain agricultural branch development on administrative regions' level.

Thus, for Briceni region (fig.1) cartographic modeling of active temperatures sum shows us that in territory 2900-2950^{0}C are dominant, the number of non-frost days is mainly 276-278 days, and for the major territory the number of days with temperature more than 5^{0}C is 223-225 days. The number of frost days is 88-89 days in the most part of republic's territory.

Frost values registered ones per 10 years are distributed on the most region's territory and constitute thermal values of -27^{0}C.

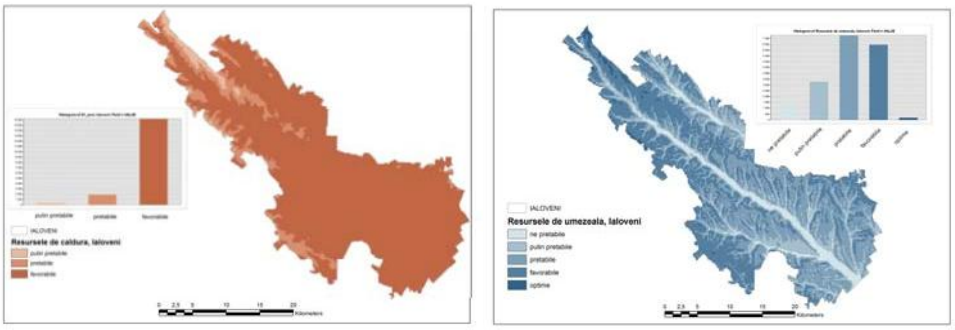
For the majority of land, atmospheric precipitations sum for warm season is 229-240 mm, in winter – 95-105 mm, and annual sums are 600-625 mm. In the biggest part of the territory maximum snow layer height constitutes 20-21 cm, and CHT coefficient is 1.2-1.3.

Integral evaluation of cartographic models for Briceni region show us that here humidity resources are in general favorable and pretable (fig.1. a) according to the summed up grading of the indexes that characterize them, while heat resources for the most territory are non-pretable for thermophile fruit crops (fig.1.b) and less pretable for the whole group of fruit crops (fig.1. c).

In republic's center, on the example of Ialoveni active temperatures sum for most region is 3300-3350^{0}C, the number of diurnal temperatures that exceed 5 ^{0}C, increases for the majority of the land and constitutes 234-236 days.

Prevailing number of days with frost decreases and is 77-79 days, and non-frost prevailing period is 296-298 days. Absolute minimum probable once per ten years for the biggest part of territory is -24^{0}C.

a b



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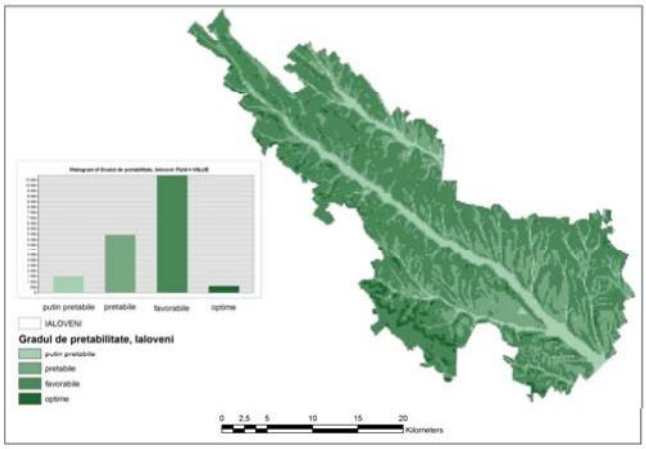

Fig. 2. Heat and humidity resources pretability evaluation (a, b) and agroclimatic ones (c) with the reference of pomiculture development in republic's Center (Ialoveni)

Prevailing annual precipitations here constitute 575-600 mm, summer ones- 200-210mm, and winter ones - 108-120 mm. Maximum snow layer height decreases down to 14-16 cm, as well as hydrothermic coefficient that constitute 1.0-1.1.

Integral evaluation of climatic and agroclimatic indexes that characterize humidity and heat resources in this administrative regions shows

us favorability and pretability of humidity resources and that heat resources are favorable. Favorable and pretable conditions for pomiculture development in general are identified according to pretability level for prevailing part of Ialoveni (fig.2. a, b, c).

In Cahul region from republic's South prevailing active temperatures sums is 3450-3500^{0}C, duration of days with diurnal temperature exceeding 5 ^{0}C is 242-245 days, frost period is the shortest and constitutes 68-70 days, and non-frost period duration is even 295-297 days, and absolute minimum once per ten years is -21^{0}C (fig.3 a).

Atmospheric precipitations annual sum on predominant part of Cahul's territory is only 525-550 mm, summer precipitations are in average 180- 190 mm, but in cold period – 95-105 mm.

Maximum height of snow layer is 11-13 cm and its the only region from those that were presented that has drought conditions according to CHT values that constitute 0.7-0.8 for the region in study (fig.3 b).

According to fig. 3, b non-pretable conditions of humidification are identified for major part of Cahul region, while heat resources in most part of it are optimal and favorable. Climate's pretability for pomiculture on Cahul region's territory is prevailingly pretable and favorable (fig. 3 c).

Thus, pretability evaluation for the regions allowed identifying local particularities of climate pretability for pomiculture.

Estimative grading method's elaboration and Geographical Informational Systems usage allows resolving one of the most difficult tasks in agroclimatology and namely climate pretability degree for certain agricultural groups of plants on the level of administrative region.

We should mention, that not so long ago it was practically impossible to layer all results of agroclimatic indexes estimation apart and integrally and that's why in major cases agroclimatic resources zonation was executed on the basis of two or three indexes. In present, basing on statistical and mathematical methods and using informational systems we are able to evaluate them on republican as well as administrative or even communal level. Obtained results can be used for authorities and private end-users informing

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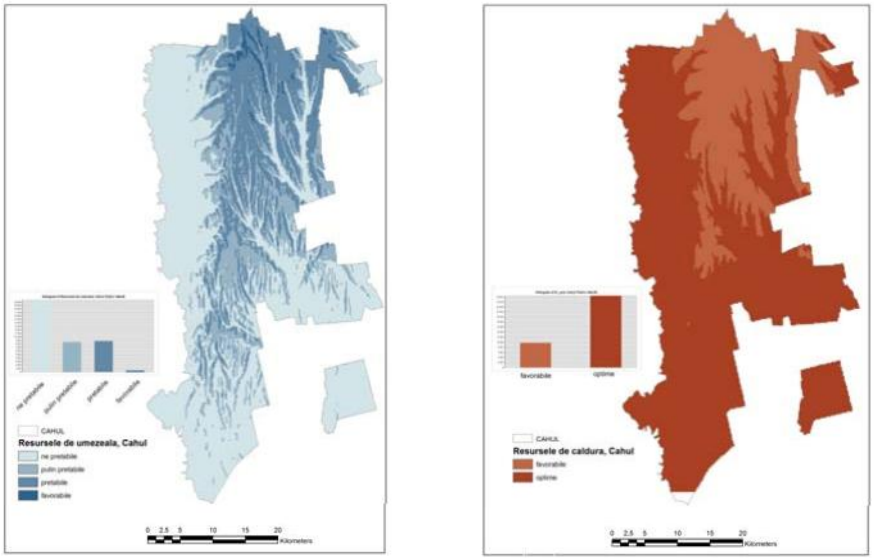

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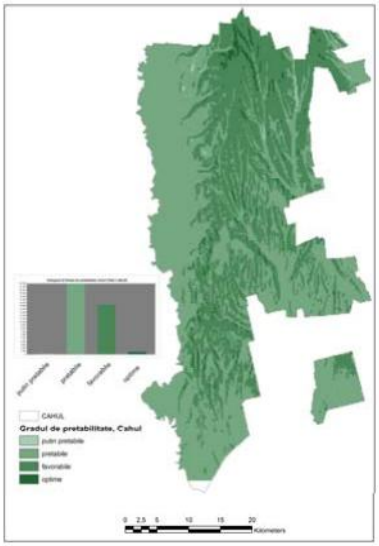

Fig. 3. Cartographic modeling of humidity resources on administrative level in republic's South (Cahul)

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